Space Weather Technical Forecast

Issued on Sunday, 06 February 2022 at 00:19 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of M-class flares (R1/R2 Radio Blackouts) throughout. Reducing Chance of isolated G1/Minor Storm activity.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: There are currently four numbered sunspot regions on the visible disc. Solar activity was low, with a number of C-class flares observed. The majority of the flares were from AR2936 a large, complex and mature region which has now disappeared across the northwestern limb. The largest flare was a long duration C5 flare, peaking at 04/1551 UTC. A coronal mass ejection (CME) was generated from this event, which has been analysed and shows it clearly missing Earth. AR2938 remains a small and simple group, but with some slight spot development. AR2939 in the southeast quadrant appears to be relatively stable, with only slight spot growth and classified as Chi/beta. AR2940 in the northeast quadrant, and close to centre disc, has intermediate spots and remains Eai/beta. AR2941 close to the northeast limb is also classified as Eai/beta, and is a potentially significant region.

Solar Wind / Geomagnetic Activity: The solar wind, as observed at L1, started the period at slightly elevated levels, before becoming elevated by 05/1000 UTC probably due to connection with a high speed stream (HSS) from CH49. Density was average to slightly above average throughout the period, with a peak of 13ppcc at 05/1645 UTC. Total magnetic field strength was predominately Weak, peaking at 9 nT at 05/0740 UTC. Bz was also Weak, ranging from +7 to -8 nT. Phi angle remained negative (towards the Sun). Geomagnetic activity was Quiet to Unsettled (Kp 1-3)

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) measured at GOES 16 was at background levels. The high energy electron flux (greater than 2MeV), started at moderate levels before breaching the High 1000 pfu value around 05/1235 UTC, peaking at 2770 pfu at 05/1800 UTC, and ending the end of the period close to the threshold level The associated 24-hour electron fluence remained below the Active threshold (1e8 integrated pfu), with an increasing trend and a value of 8.99e7 integrated pfu at 06/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is likely to be mostly low, with a chance of M-class flares and a very slight chance of X-class flares.

Solar Wind / Geomagnetic Activity: Solar winds starting the period at elevated levels during today (06 Feb), due to connection with a coronal hole high speed stream (CH HSS), with speeds 500-550 km/s. Further CH HSS connections with similar speeds are possible and this will likely maintain slightly elevated to elevated solar winds. Geomagnetic activity is likely to be Quiet to Unsettled (Kp1-3) with probable Active (Kp4) intervals at times and a chance (20-30%) of a minor geomagnetic storm (G1) interval, although this probability will reduce to a slight chance for

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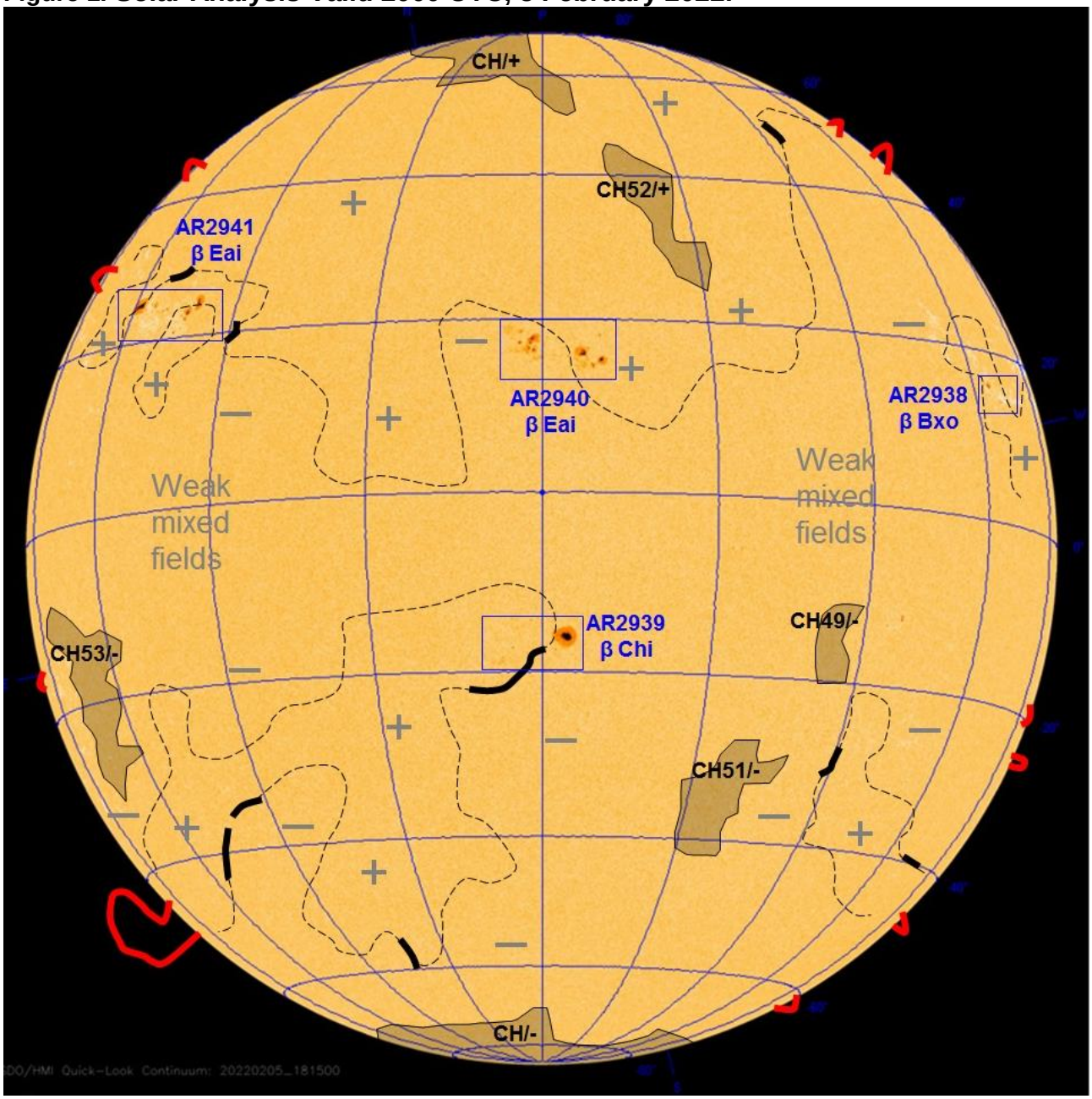
days 3 and 4 (8th and 9th Feb).

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is forecast to be at background to moderate levels but with a slight chance of rising close to or just above the S1 level given any significant M-class flaring. High energy electron flux (greater than 2MeV) is expected to breach the High (1e3 pfu) threshold daily and probably becoming predominantly High by day 2 (7th). Electron fluence starting below the Active (1e8 integrated pfu) threshold is forecast to increase to breach the Active threshold by day 2 (7th).

Figure 1. Solar Analysis Valid 2000 UTC, 5 February 2022.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

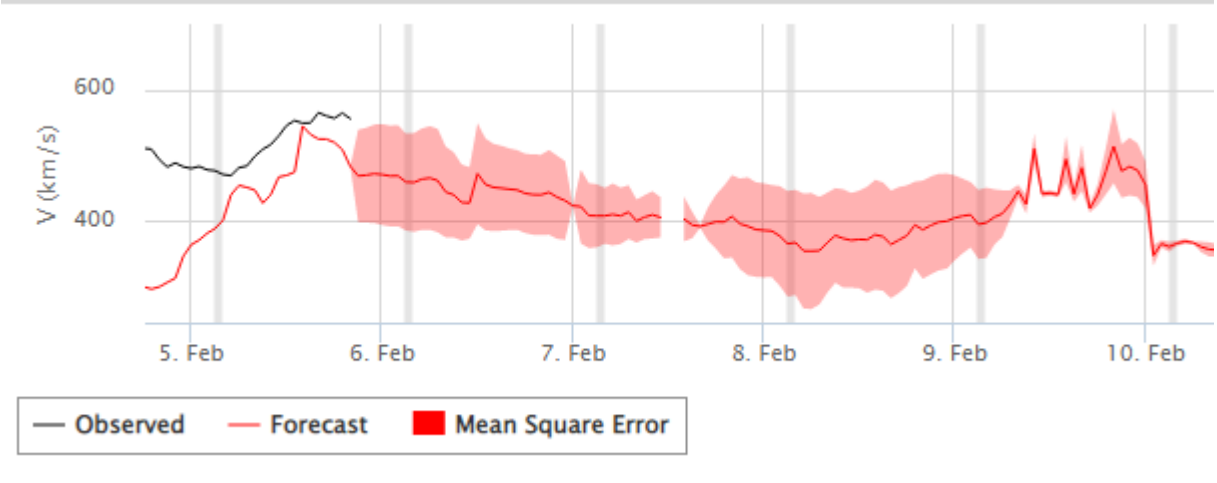
The high speed stream from coronal hole 49 has connected with Earth with solar winds just above 550 km/s, and this will slowly decline through day 1 (6 Feb). Another high speed stream from coronal hole 51 is then likely to connect by day 2 (07 Feb), with elevated solar winds likely. From day 3 (08 Feb) the influence of the CH HSS will decline, with solar winds reaching slow-ambient to slightly elevated values but the Met Office Solar Winds Prediction Model (SWPM) is indicating a further enhancement on day 4 (9 Feb), which is not anticipated to occur. Geomagnetic activity is likely to be Quiet to Unsettled (Kp1-3) with probable Active (Kp4) intervals at times and a chance (20-30%) of a minor geomagnetic storm (G1) interval, although this probability will reduce to a slight chance for days 3 and 4 (8th and 9th Feb).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	30	20	10	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

Figure 2: Met Office Solar Winds Prediction Model (SWPM) showing slightly elevated to elevated winds.



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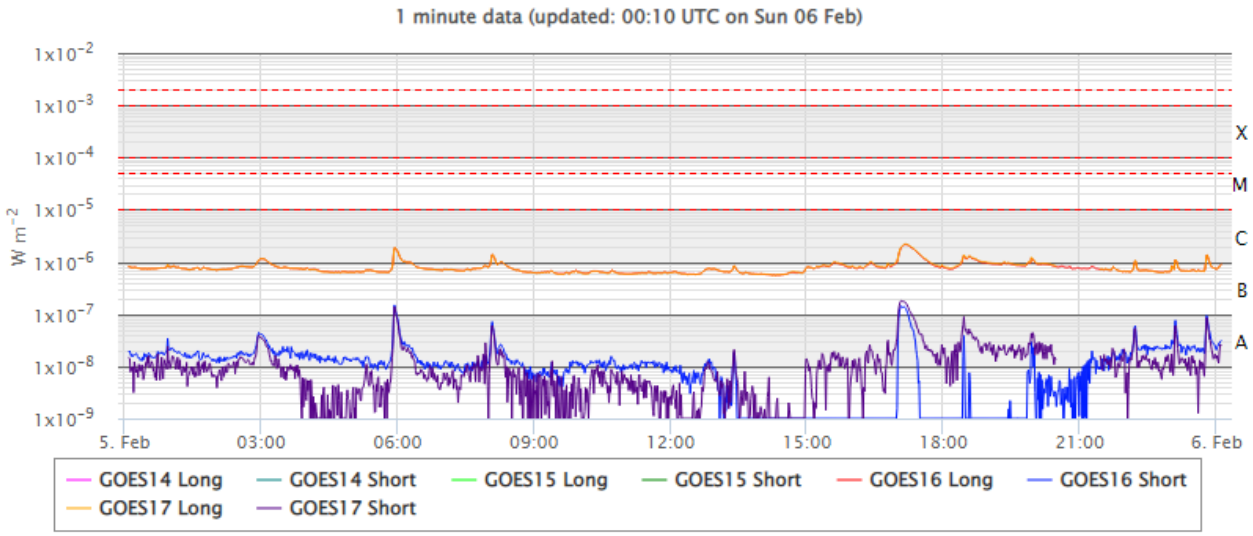
Radio Blackouts - X-Ray Flares:
Solar activity is expected to remain mainly low over the next four days, with a slight chance of M-class flares and a very low risk of X-class flaring.
There are four significant sunspot regions on the visible disc. AR2936 in the northwest quadrant, has now rotated off the visible disc -hours, following a relatively dormant period through the previous seven days, generating a long duration C5 flare on 4 Feb. Two regions in the northwest quadrant 2940 and 2941 are both bi-polar and classified Eai/Beta and currently present the highest flare risk. AR2938 has become less prominent in recent days and will follow AR2936 to rotate off the visible disc in the next 24 hour. AR2939 in the southeast quadrant appears complex but stable and carries a lower risk of M-class flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	25	20	20	10
Very Active	R3 to R5 X Class	No	2	2	2	1

Figure 3: X-Ray flares plot at GEO, with a number of C-class flares over the past 24 hours.



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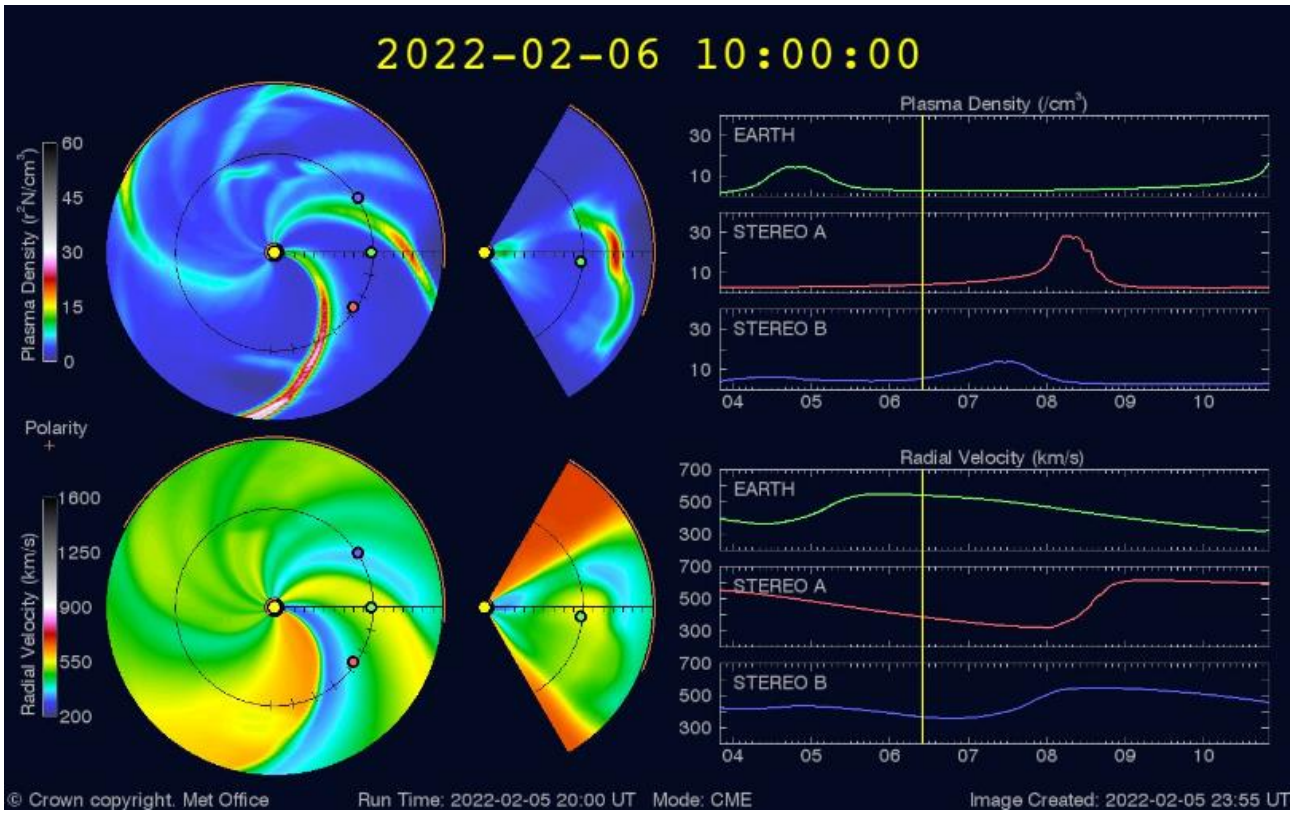
Solar Radiation Storms - (High Energy Protons):

The high energy proton flux, as measured by GOES-16 is at background levels. Solar radiation storms are not likely in the period, however there is a slight chance (2-5%) for proton fluxes to rise given any significant flaring.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	2	2	5	5
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: Met Office ENLIL model showing HSS from CH49 affecting Earth during 6 February.



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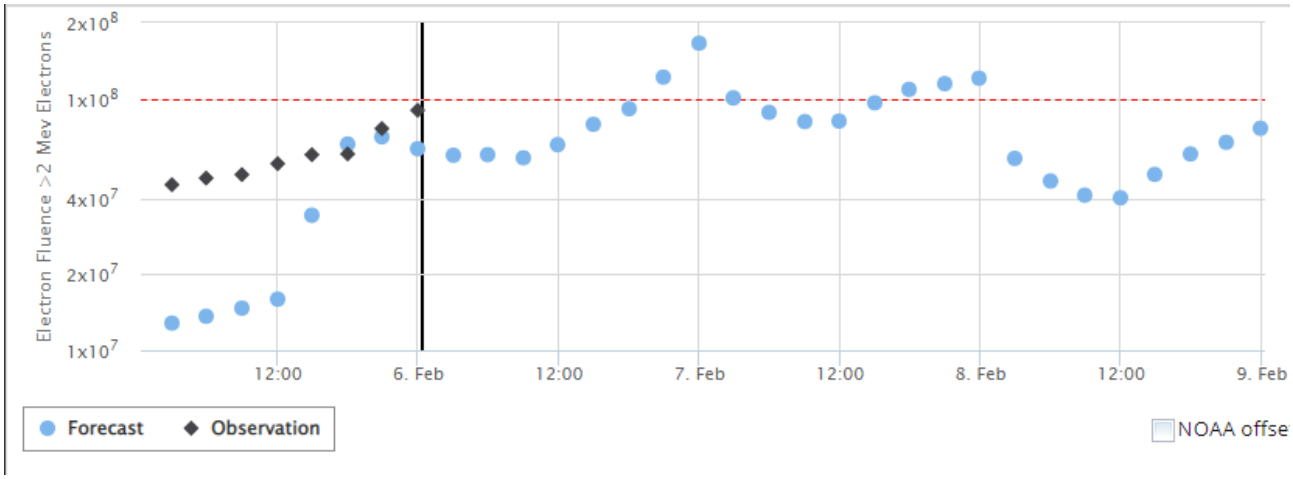
High Energy Electrons Event (≥ 2MeV):
The two high speed streams connecting with Earth are likely to further distort the radiation belts and redistribute electrons within the belts. As associated geomagnetic activity declines there is an increasing chance of higher energy flux values which will exceed the High (1000 pfu) threshold, with generally High flux values through the period.
Electron fluence levels starting the four day period below the Active (1e8 integrated pfu) threshold increasing to breach the Active threshold by day 2 (07 Feb), and currently the upward trend as depicted by the Met Office REFM model is considered to be good guidance.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	70	90	90	80
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	5	5	5

Figure 5: Met Office REFM output with a strong indication for fluence levels to rise above the threshold in the next 6 to 12 hours.



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